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A Longitudinal Test of the Theory of Planned Behavior Predicting Smoking Onset among Asthmatic and Non-asthmatic Adolescents

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Abstract Despite the particularly detrimental health risks of smoking for adolescent with asthma, several studies demonstrated higher smoking rates among asthmatic adolescents than among healthy adolescents. To gain insight into underlying mechanisms, longitudinal studies on differences in smoking predictors between asthmatic and non-asthmatic adolescents are essential. This longitudinal study with two waves with an 18 months interval tests the Theory of Planned Behavior (TPB) among 346 asthmatic adolescents and 3,733 non-asthmatic adolescents aged 12–16 years. Structural equation models were used to test the predictive value of the TPB in these two groups. The results show, consistent with the TPB, that smoking-related cognitions (attitude, perceived behavioral control, and subjective norm) predict smoking onset via intention among both asthmatic and non-asthmatic adolescents. The TPB predicted smoking onset even stronger among adolescents with asthma. These findings may contribute to the development of tailored interventions for the prevention of smoking among asthmatic adolescents.

Keywords Asthma · Adolescent · Cognition · Tobacco use · Risk factors · Longitudinal

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Introduction

Worldwide, tobacco use causes around 5 million deaths per year, and is the most common cause of preventable deaths nowadays (WHO 2003). Despite awareness of the health risks of smoking, many adolescents take up smoking during adolescence. In the Netherlands, in 2005 the prevalence of ever smoking was 35%, 43%, 49% for 13, 14 and 15 year olds, respectively (Stivoro 2006). Those who experiment with smoking in early adolescence have higher odds to become regular smokers than those who start later in life (Pierce and Gilpin 1996). Therefore, preventing adolescents to start experimenting with smoking is an adequate way to decrease mortality and morbidity caused by tobacco use. This is even more important for adolescents with asthma, since the health risks of active smoking are higher for persons with asthma: smoking is related to an increase in symptoms of asthma (Siroux et al. 2000), an increased risk of developing chronic obstructive pulmonary diseases (COPD) (George 1999), and a reduced efficacy of corticosteroid treatment (Chalmers et al. 2002). Remarkably, several studies have found that smoking is more common among asthmatic adolescents (Forero et al. 1996; Precht et al. 2003; Zbikowski et al. 2002), with asthmatic adolescents being up to 2.55 more likely to be daily smokers than non-asthmatic adolescents (Forero et al. 1996).

One of the most influential theories predicting smoking onset, the theory of planned behavior (TPB) (Ajzen 1991) has been used for designing many theory-based smoking prevention programs for the general population of adolescents (e.g., Cuijpers et al. 2002; De Vries et al. 2003). However, we do not know whether these interventions are appropriate for adolescents with asthma, as it is unknown whether smoking is predicted by the same factors among

adolescents with asthma as among their non-asthmatic peers. Therefore, the current study compares predictors of smoking onset among adolescents with and without asthma, by focusing on the smoking-specific cognitive predictors from the TPB.

The TPB suggests that a certain behavior can be predicted by a person's intention to perform that behavior, which in turn is determined by three cognitive factors: attitudes (the cognitive-affective evaluations of that behavior), perceived behavioral control (PBC) (perceived competence to perform that behavior), and subjective norm (approval of that behavior by significant others). According to the TPB, adolescents with a positive attitude towards smoking, a low PBC to refrain from smoking, and adolescents perceiving a subjective norm approving of smoking will have a stronger intention to start smoking and in turn are more likely to take up smoking.

Among the general population of adolescents, this theory has been tested in numerous studies, both cross-sectionally and longitudinally. Although cross-sectional designs are useful to explore relations between variables, longitudinal designs are more appropriate in revealing the order of events. For example, a positive relationship between attitude towards smoking and smoking behavior in cross-sectional studies does not reveal whether this is due to attitude influencing the onset of smoking, or whether smoking onset caused attitudes to become more positive towards smoking (Festinger 1957). To design effective interventions, predictors of smoking onset need to be identified, and therefore longitudinal designs are much more informative. Several longitudinal studies showed that the cognitive concepts from the TPB are valuable in predicting smoking onset of adolescents (e.g., De Vries et al. 1995; Flay et al. 1994; Harakeh et al. 2004; Huver et al. 2006). A recent study by Wilkinson and Abraham (2004), that compared the predictive value of several previously identified correlates of smoking, stressed the importance of smoking-specific cognitions in predicting smoking onset among adolescents. Research supported TPB's assumption that the smoking specific cognitions influence smoking mainly via intention to start smoking (De Vries et al. 1995), and PBC is found to be the strongest predictor of smoking (e.g., Flay et al. 1994; Harakeh et al. 2004).

Among asthmatic adolescents, the TPB has not been tested longitudinally. Moreover, to our knowledge, only two studies concentrated on differences in smoking-specific cognitions between adolescents with and without asthma. Brook and Shiloh (1993) showed that adolescents with asthma had more negative attitudes towards smoking and a lower intention to start smoking than non-asthmatic adolescents. On the contrary, no differences in smoking-specific cognitions were found in a more recent study (Van De Ven et al. 2006). Both studies were cross-sectional, analyzing smoking behavior in a sample with both non-smoking and smoking adolescents. The present longitudinal study will examine onset of smoking in a sample of exclusively non-smoking youths, with smoking-specific cognitions measured preceding smoking onset.

With regard to the role of smoking-specific cognitions in predicting smoking onset, only two studies focused on the association between smoking-specific cognitions and smoking behavior in adolescents with asthma, both of cross-sectional nature. Zbikowski and colleagues (2002) investigated the relations between several intrapersonal and psychosocial risk factors and adolescent smoking. Among these variables they included "perceived value of smoking", which closely relates to attitudes. Differences between asthmatic and non-asthmatic adolescents in the relation between perceived values and smoking were examined. Only one item differed significantly between the two groups: the belief that smoking was relaxing was only associated with smoking among asthmatic adolescents. A recent cross-sectional study tested the associations between the smoking-specific cognitions from the TPB and smoking in a large sample of adolescents with and without asthma (Van De Ven et al. 2006). Results showed that, for both pro-smoking attitudes and PBC to refrain from smoking, the relation between these cognitions and smoking behavior was stronger among asthmatic adolescents than among non-asthmatic adolescents. Even though these findings suggest that smoking specific cognitions and intention may play a more important role in smoking onset for adolescents with asthma, alternative interpretations cannot be ruled out. For example, the findings may be caused by cognitive dissonance reduction (Festinger 1957): when there is an inconsistency between cognition and behavior, people tend to change their cognitions. Since smoking has more detrimental effects for adolescents with asthma, the conflict between cognitions and behavior may be larger among smoking adolescents with asthma and therefore, they may experience an even stronger need to change their cognitions into even more pro-smoking cognitions after initiating smoking.

Several studies point to possible differences in the strengths of associations between the concepts of the TPB when adolescents with and without asthma are compared. First, the before-mentioned cross-sectional studies (Zbikowski et al. 2002; Van De Ven et al. 2006) show that the relation between attitude towards smoking and PBC on the one hand and smoking behavior on the other is stronger among asthmatic adolescents. Secondly, cross-cultural differences in the performance of social cognitive theories have been found (Godin et al. 1996). Godin and colleagues suggest that culture may affect cognitions about a certain behavior via beliefs of how a "person like me" should behave. One might assume that these kinds of differences

may be found between asthmatic and non-asthmatic adolescents as well, since for adolescents with asthma, the norms about smoking in the society are different (less approving) than the norms for non-asthmatic adolescents. Thirdly, studies point to different factors that could moderate the strength of the effect of cognitions on behavior. Cooke and Sheeran (2004) describe several moderators, such as accessibility, temporal stability, certainty and involvement. Due to the health risks associated with smoking, asthmatic adolescents might contemplate more on smoking. Therefore, cognitions about smoking might be more accessible, stable, relevant, and certain, thereby strengthening the relationship between cognition and behavior.

These studies together show that the performance of the TPB might differ in asthmatic and non-asthmatic adolescents. We hypothesize that the concepts of the TPB are stronger predictors for smoking onset in adolescents with asthma than in non-asthmatic adolescents. To test this hypothesis, the present longitudinal study (18 months interval) among 4,079 adolescents addresses two questions: Do adolescents with asthma differ from non-asthmatic adolescents with respect to (1) smoking-specific cognitions at T1 (time 1), and (2) the value of the concepts of the TPB for predicting smoking onset. In line with previous cross-sectional studies we expected a lower intention to start smoking among adolescents with asthma and we did expect to find no differences in PBC and subjective norm. Due to conflicting evidence in these studies, no hypothesis was formulated about attitude towards smoking. Concerning the effect of the concepts of TPB on smoking onset, we expected generally stronger effects for adolescents with asthma than for non-asthmatic adolescents.

Method

The present longitudinal study on smoking behavior among asthmatic and non-asthmatic adolescents was approved by the medical ethical committee (CMO Arnhem-Nijmegen). For this paper, adolescents who reported to have never smoked on T1 were included in the analyses. Attitude, subjective norm, PBC, and intention were measured at T1; smoking behavior was measured at T1 and T2 (time 2).

Participants

Thirty-three secondary schools across the Netherlands participated in this study. Data collection of T1 took place in May 2003; the second questionnaire was administered 18 months later in November 2004 (T2). At T1, all students from the first two classes of the secondary schools were included in this study. Of the 9,642 respondents who filled out the first questionnaire, 7,152 adolescents (74.2%) filled out both questionnaires consistently and completely. Because students did not know when the questionnaires were to be distributed, we assume non-response was primarily due to illness, leaving school or moving to another school. Of this sample, 4,368 adolescents reported they had never smoked at T1. Because 36 respondents had missing data on their smoking behavior on T2, they were excluded from the analyses.

We identified asthmatic adolescents by using an extended version of a Dutch translation (Wieringa et al. 1999) of the asthma questionnaire of the International Study of Asthma and Allergies in Childhood (ISAAC). This questionnaire is designed for population based research and has proven to be a valid instrument for assessing the prevalence of asthma (Asher et al. 1995; Pearce et al. 1993; Shaw et al. 1995). The respondents were identified as having current asthma or never asthma based on their responses to three items. The 346 students with current asthma all responded they had asthma at some point in their lives, and they either had asthma in the past 12 months, or they used asthma medication in the past 12 months. A total of 3,733 students responded they never had asthma. Students who reported to have a history of asthma but were not asthmatic in the past 12 months, nor used asthma medication in the past 12 months (n = 208) were excluded from the analyses because of the high diversity of this group (ranging from experiencing only one asthma-attack in the first year of life to having had asthma from early on in life till just recently). The final sample for this paper thus consisted of 4,079 respondents. As shown in Table 1, most respondents (83.2%) were of Dutch origin, and there was a slight overrepresentation of girls in the sample (52.9% girls vs. 47.1% boys). All levels of the Dutch school system were represented in the sample. The mean age of the respondents was 13.2 (SD = .74) at T1 (Table 2).

Procedure

For both T1 and T2, all students filled out a written questionnaire during school hours, under supervision of a teacher. All teachers received instructions about the procedure and how to handle questions from the students. Furthermore, they were asked to remind the students that the data would be processed anonymously and to note which students were absent and the reason for that absence. To increase motivation, the instruction for the students mentioned that CD gift vouchers (of 20 euro) would be raffled among students who filled out their questionnaire seriously.

Table 1 Demographic characteristics of adolescents who never had asthma and adolescents who currently have asthma

		Total sample	Never asthma	Current asthma	χ^2
N		4,079 (100%)	3,733 (91.5%)	346 (8.5%)	
Sex	Female	52.9%	53.4%	51.9%	3.53
	Male	47.1%	46.6%	48.1%	
Ethnic background	Non-Dutch	16.8%	16.9%	15.4%	.49
	Dutch	83.2%	83.1%	84.6%	
Education level	Low	29.6%	29.5%	29.7%	.06
	Intermediate	19.6%	19.6%	19.1%	
	High	50.9%	50.8%	51.3%	
Intention	Sure never start smoking	58.5%	57.5%	69.7%	19.23*
	Think never start smoking	40.0%	41.0%	29.2%	
	Think start smoking	1.5%	1.5%	1.2%	
Smoking onset	No	74.7%	74.4%	78.0%	2.16
	Yes	25.3%	25.6%	22.0%	

Note: *$p < .001$

Table 2 Means of age and smoking-specific cognitions at baseline for adolescents who never had asthma and adolescents who currently have asthma

	Never asthma	Current asthma	*t*-Value
Mean age	13.2 (.73)	13.1 (.78)	1.32
Attitude	1.46 (.68)	1.39 (.56)	2.16*
PBC	4.30 (.57)	4.38 (.53)	–2.23*
Subjective norm friends	2.01 (.80)	2.06 (.78)	–1.32
Subjective norm parents	1.32 (.61)	1.29 (.61)	.92

Note: *$p < .05$. Data are expressed in means; values in parentheses represent standard deviations

Measures

All items and response scales of the questionnaires used in this study are described in the Appendix. The measures used in the present study have been used in various studies on adolescent smoking behavior, and have proven to be valid instruments to assess the TPB (Harakeh et al. 2004; De Vries et al. 1988; Van Zundert et al. 2006).

Pro-smoking Attitude

Seven items on a 7-point scale assessed the attitude towards regular smoking (Dijkstra et al. 2001). Participants were asked to indicate whether they evaluated smoking positively or negatively (e.g., I think daily smoking is (1) boring to (7) exciting). Responses to these items were averaged to form a score for pro-smoking attitude. Internal consistency for these items was good (Cronbach's alpha (α) = .81).

Perceived Behavioral Control (PBC) (Perceived Ability to Resist Smoking)

Perceived behavioral control was measured by six items on a 5-point scale ranging from very difficult to very easy to refrain from smoking in certain situations (e.g., To refuse a cigarette when it is offered to me is… very difficult (1) to very easy (5) for me) (De Vries et al. 1988; Engels et al. 1998). Responses were averaged to yield a score for PBC (α = .79).

Subjective Norm

Three items asked about whether the respondent thinks that important others (best friend, friends and parents) would approve of him/her smoking; (definitely not (1) to definitely yes (4)) (De Vries et al. 1995). The responses for the two items asking about best friend and other friends were averaged to form a score for subjective norm of friends (α = .74). Subjective norm parents and subjective norm friends were entered separately in the model.

Intention

Intention to smoke was measured by a single item on a 7-point scale ranging from (1) I am sure I will never start smoking to (7) I think I will start smoking within a month (Harakeh et al. 2004; Kremers et al. 2001). Because of the skewness of the distribution of intention to smoke, this variable was recoded into 3 categories (I am sure I will never start smoking, I think I will never start smoking, I think I will start smoking).

Smoking Behavior

Smoking behavior at T1 and T2 was assessed by a single item on a 9-point scale ranging from (1) I never smoked, not even a puff to (9) I smoke at least once a day (Kremers et al. 2001). At both T1 and T2, this variable was dichotomized into 1 (never smoked) versus 2 (smoked once or more) because of the skewness of the distribution of this variable. Only adolescents who never smoked at T1 were included in this study. Assessing smoking among adolescents by self-reports showed to be valid (Barnea et al. 1987; Forastiere et al. 1993), and the instrument used in the present study has been used in various health studies in the Netherlands (Engels et al. 2004; Harakeh et al. 2004; Van De Ven et al. 2006).

Statistical Analysis

First, Pearson correlation coefficients were calculated for the smoking-specific cognitions. Subsequently, *t*-tests were conducted to test for differences in smoking-specific cognitions between adolescents with and without asthma and chi-square tests were conducted to test for differences in smoking intention and smoking onset. To examine the TPB in asthmatic and non-asthmatic adolescents, structural equation models (SEM) were tested with the software package Mplus (Muthén and Muthén 2001). SEM serves purposes resembling multiple regression, but has several advantages over regression (e.g., reducing measurement error by using latent variables with multiple indicators and testing overall models instead of individual coefficients). Missing values were handled by the full-information maximum likelihood (FIML) approach with the help of the expectation maximization (EM) algorithm: missing values were estimated using the available information in the dataset by casewise maximizing the likelihood of the observed data (Wothke 2000).

Weighted Least Square Method with adjusted mean- and variance chi-square statistics (WLSMV estimator) was used to test the model of the TPB. We used parcels as indicators for the latent variables "attitude" and "PBC" (Bandalos and Finney 2001). Parcels are subsets of scale items. First, principal component factor analysis using SPSS was used to determine the factor loadings of each of the attitude and PBC items. For both attitude and PBC, items with corresponding factor loadings were divided over two subsets of scale items, leading to two parcels for "attitude" and two parcels for "PBC". Subjective norm of friends was also estimated by 2 indicators: one item about the subjective norm of the best friend, one item about other friends. To measure subjective norm of the parents, intention and smoking behavior, the observed scores were used. Initially, a model with full mediation by intention was tested. Non-significant paths were removed, and paths were added to the model when the fit of the model improved. The chi-square value with degrees of freedom and the *p*-value of the model are calculated. However, because the chi-square is extremely sensitive to sample size, other fit measures (independent of N) were examined to evaluate the fit; the comparative fit index (CFI) and the root mean square error of approximation (RMSEA). For CFI, values greater than .95 indicate a good fit between the model and the data, for RSMEA, values below .05 indicate a good fit (Kaplan 2000). The model is tested separately for adolescents who currently have asthma and for adolescents who never had asthma.

Results

Chi-square tests and *t*-tests showed that the adolescents with asthma did not differ significantly from the adolescents who never had asthma on socio-demographic characteristics (gender, ethnic background, education level and age). Furthermore, smoking onset between baseline and follow-up did not significantly differ between adolescents with asthma (22.0%) and the non-asthmatic adolescents (25.6%), χ^2 (1, N = 4,079) = 2.16, p = .14 (Table 1). However, differences were found with regard to the smoking-specific cognitions measured at baseline: Adolescents with asthma had a lower intention to start smoking, a more negative attitude towards smoking, and a higher PBC to refrain from smoking (Table 2). Subjective norm of friends and parents did not significantly differ between the two groups.

Table 3 describes the standardized factor loadings and correlations of the latent factors of the Mplus model for the adolescents with and without asthma. The standardized factor loadings vary between .71 and .91, and are thus sufficiently high. Moreover, correlations indicated that in both groups, having a more positive attitude towards smoking was related with a lower PBC to refrain from smoking and a more approving subjective norm (parents and friends). Furthermore, a higher PBC was related to a less approving subjective norm of parents (both groups) and a less approving subjective norm of friends (only significant among the non-asthmatic adolescents). Finally, the subjective norm of parents and friends were positively related in both groups.

The Predictive Value of the TPB for the Non-asthmatic Adolescents

Figure 1 shows the paths of the model of the non-asthmatic adolescents with standardized regression weights. The fit

Table 3 Standardized factor loadings and intercorrelations of the latent factors of the model for adolescents who never had asthma and adolescents who currently have asthma

	Never asthma	Current asthma
Factor loadings		
Attitude → Attitude parcel 1	.84**	.80**
Attitude → Attitude parcel 2	.86**	.77**
PBC → PBC parcel 1	.75**	.71**
PBC → PBC parcel 2	.84**	.82**
Subjective norm friends → Subjective norm best friend	.84**	.82**
Subjective norm friends → Subjective norm other friends	.90**	.91**
Correlations		
Attitude ↔ PBC	–.38**	–.38**
Attitude ↔ Subjective norm friends	.25**	.29**
Attitude ↔ Subjective norm parents	.19**	.28**
PBC ↔ Subjective norm friends	–.17**	–.09
PBC ↔ Subjective norm parents	–.09**	–.14*
Subjective norm friends ↔ Subjective norm parents	.38**	.29**

Note: *$p < .05$; **$p < .001$

indices showed that the model fitted the data well (CFI above .95, RMSEA was .05). Twenty-six percent of the variance in intention and 7% of the variance in smoking onset was explained by the model. The results are in line with the TPB. Adolescent with a more positive attitude towards smoking, lower PBC and a high pro-smoking subjective norm of parents and friends had a higher intention to smoke, which in turn predicted smoking onset. Furthermore, a higher attitude and a more pro-smoking subjective norm of parents had a direct effect on smoking onset.

The Predictive Value of the TPB for the Adolescents with Asthma

Figure 2 shows the paths of the model of the asthmatic adolescents with standardized regression weights. The model fitted the data well (CFI above .95, RMSEA below .05). The explained variance of the model of the asthmatic adolescents was higher, especially for smoking onset: 36% of the variance in intention and 16% of the variance in smoking onset was explained by the model. In general, the model was similar to that of the non-asthmatic adolescents, and the results are in line with the TPB, except that subjective norm of friends was not related to intention among the asthmatic adolescents. Adolescent with a more positive attitude towards smoking, lower PBC and a high pro-smoking subjective norm of parents had a higher intention to smoke, which in turn predicted smoking onset. The regression weights of this model are higher than the weights in the model of non-asthmatic adolescents. The longitudinal path between intention and smoking onset is even twice as large in the model for asthmatic adolescents than in the model of non-asthmatic adolescents.

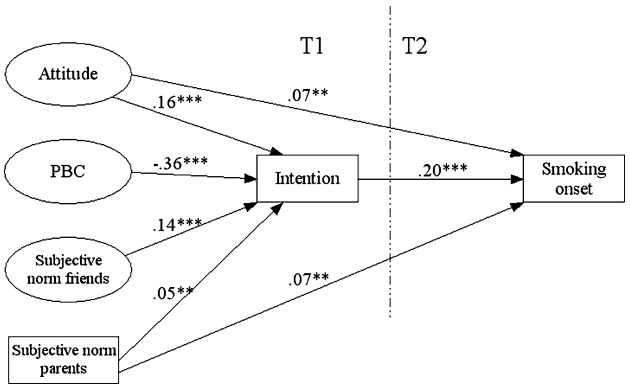

Fig. 1 Structural Equation model with standardized coefficients for testing the TPB among the non-asthmatic adolescents. R^2 intention = .26; R^2 smoking onset = .07; N = 3,733, χ^2 [20] = 218.89, P = .000, CFI = .984, RMSEA = .052. *$p < .05$; **$p < .01$; ***$p < .001$

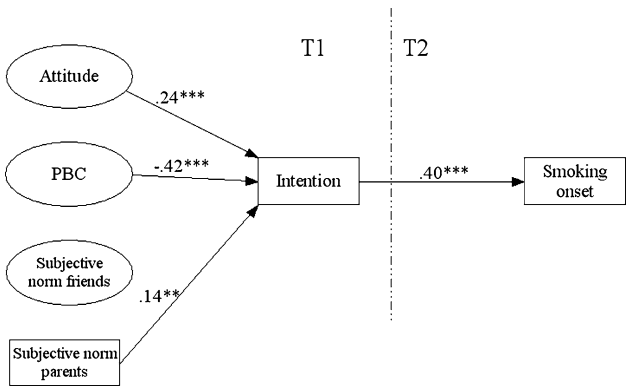

Fig. 2 Structural Equation model with standardized coefficients for testing the TPB among the asthmatic adolescents. R^2 intention = .36; R^2 smoking onset = .16; N = 346, χ^2 [23] = 37.05, P = .032, CFI = .983, RMSEA = .042. *$p < .05$; **$p < .01$; ***$p < .001$

Discussion

The purpose of the present study was to test the value of the TPB for predicting smoking onset in asthmatic and non-asthmatic adolescents. The results show, in line with the TPB, that smoking-related cognitions (attitude, PBC, and subjective norm) predict smoking onset via intention among both asthmatic and non-asthmatic adolescents. However, the smoking-specific cognitions of the TPB explained more of the variance in smoking onset among asthmatic adolescents.

Differences in Level of Smoking-specific Cognitions and Intention between Asthmatic and Non-asthmatic Adolescents

Although the results were generally in agreement with the TPB, we found differences between the two groups. With regard to the mean level of smoking-specific cognitions, adolescents with asthma had a more negative attitude towards smoking and a higher PBC to refrain from smoking. Previous studies on differences in smoking-specific cognitions between asthmatic and non-asthmatic adolescents used samples including both smoking and non-smoking adolescents, and reported contradictory results. With regard to attitudes towards smoking, Brook and Shiloh (1993) found more negative attitudes among asthmatic adolescents, whereas other studies (Zbikowski et al. 2002; Van De Ven et al. 2006) found no differences in attitude between asthmatic and non-asthmatic adolescents. No differences were found for PBC and subjective norm (Van De Ven et al. 2006). The present study measured smoking-specific cognitions exclusively among non-smokers at baseline to avoid ambiguity due to mixing findings for non-smoking adolescents and those who already smoke. Adolescents with asthma were found to have more negative cognitions about smoking.

This is in contrast with the previous mentioned cross-sectional studies (Zbikowski et al. 2002; Van De Ven et al. 2006), in which both smokers and non-smokers were included, and in which no differences were found. When including only non-smokers in the present study, asthmatic adolescents more strongly endorsed anti-smoking cognitions, but when smokers and non-smokers were considered together, no such difference was found. Asthmatic adolescents seem to have adjusted their cognitions more than the non-asthmatic adolescents after smoking onset, suggesting a larger cognitive dissonance reduction in asthmatic adolescents.

Further, asthmatic adolescents had a lower intention to smoke than the non-asthmatic adolescents. This might be caused by the higher perceived risks of getting lung diseases (Van De Ven et al. 2006) among adolescents with asthma. Because they are aware of their increased health risks, they intent to refrain from smoking. In addition, one would also expect a lower intention to smoke among asthmatic adolescents due to parental pressure, i.e., we expected that parents are aware of the increased health risks associated with smoking for asthmatic adolescents and would therefore be less approving of their child's smoking. Nevertheless, the lack of differences in subjective norms of parents of asthmatic and non-asthmatic adolescents seems to indicate that there is no increased pressure from parents of asthmatic adolescents to refrain from smoking. This is in line with a recent study (Otten et al. 2005) showing that asthmatic adolescents were more likely to have parents who smoke, indicating that parents of asthmatic children do not quit smoking because their child is suffering from asthma.

Differences between Asthmatic and Non-asthmatic Adolescents in Smoking Onset

Although asthmatic adolescents have a lower intention to start smoking, their smoking onset is not significantly different from the onset of non-asthmatic adolescents. This is in line with some cross-sectional studies on smoking behavior of asthmatic and non-asthmatic adolescents (e.g., Forero et al. 1992), although several studies found a higher prevalence of smoking among adolescents with asthma (e.g., Precht et al. 2003). However, it is important to note that due to the cross-sectional nature of these studies it is not sure whether asthma preceded smoking onset, or whether smoking preceded the development of asthma.

Relations between Smoking-specific Cognitions, Intentions and Smoking Onset

The results of the present study demonstrated differences in mean levels of smoking-specific cognitions and intentions, but not in onset. These findings raise the question how the concepts from the TPB relate to smoking intention and onset among the two groups. Differences in the associations between cognitions and intentions were found. Among asthmatic adolescents, subjective norm of friends was not related with intention to smoke, while it was related to intention among non-asthmatic adolescents. This might be explained by the fact that asthmatic adolescents are still more dependent on their parents' opinions and behaviors due to for example shared medication management. Therefore, they may be influenced more by the subjective norm of parents than the norm of friends. This is in line with the results, which show that the path from norm of parents to intention is almost three times as high for asthmatic adolescents than among the non-asthmatic adolescents. This indicates that asthmatic adolescents are

affected more by the parental norm towards smoking than non-asthmatic adolescents.[1] Even though we did not find differences in the means of parental subjective norm between asthmatic and non-asthmatic adolescents, the results indicate that it is more important for parents of asthmatic adolescents to disapprove smoking.

Furthermore, the models of the two groups differ with respect to the direct paths from attitude and subjective norm of parents to intention to smoke, i.e., these pathways are only significant among non-asthmatic adolescents. However, these differences may be caused by the large difference in sample size. Because of the smaller sample of asthmatic adolescents, it is possible that regression weights of the direct paths would have similar strengths to that of the non-asthmatic adolescents but fail to reach significance.

Overall, the models seem to suggest that the TPB is more predictive of smoking onset among asthmatic adolescents than among non-asthmatic adolescents, i.e., the proportion of variance explained by the model is twice as high among the asthmatic adolescents, and the path between intention and smoking onset is twice as high as well. This higher predictive power among asthmatic adolescents might result from differences in the need for acceptance of others. Because of their asthma, their need to use medication, and the impact asthma can have on daily living (e.g., harder to join in playing sports and going to parties, complying with lifestyle advice) (Lenney 1997), asthmatic adolescents might feel different from their peers. This is in line with studies on the well-being of asthmatic adolescents showing more internalizing behavior problems among asthmatic children and adolescence (e.g., Alati et al. 2005). Since smoking may be a way to obtain status during adolescence (Spijkerman et al. 2005), asthmatic adolescents who already have positive cognitions towards smoking may be more inclined to actually start smoking.

[1] To test whether the differences in associations between subjective norm of parents and intention to smoke are caused by differences in parental smoking, we conducted additional analyses including parental smoking in the model (with a direct path to smoking onset, as well as an indirect path via intention). If the relation between subjective norm of parents and intention can be explained by parental smoking, the regression weights of subjective norm parents and intention would decrease. Including parental smoking in the model did not significantly alter the model findings in both groups. The same paths between the variables of the TPB, smoking intention and smoking onset were significant. Most of the regression weights did not change either, except for small changes the in regression weights of subjective norm of parents. For the non-asthmatic adolescents, subjective norm parents to intention became .04 instead of .05 after including parental smoking, and the regression weight of subjective norm parents to smoking onset became .06 instead of .07. For the asthmatic adolescents, subjective norm parents to intention became .13 instead of .14. Although a small decrease in the effect of subjective norm parents was found, this did not significantly change the model, indicating that in both groups, the effect of subjective norm of parents was hardly affected by parental smoking behavior.

Another explanation for the relative high predictive power of the TPB for asthmatic adolescents may be found in the prototype-willingness model (Gibbons et al. 1998, 2006). According to this model there are two pathways to health behavior. The first is the reasoned path, an intentional path analogous to the path suggested by the TPB. Many theories on health behavior assume that adolescents' health behavior is preceded by a deliberate consideration of options, pros and cons. However, as argued by Kremers and colleagues (2004), most adolescents only start thinking about whether or not to be a smoker after trying it a few times. According to the prototype/willingness model, much of the initial engagement of adolescent health-risk behavior is not deliberately planned but a response to social circumstances. Therefore, the model has a second pathway: a social reaction path. When adolescents are in a situation facilitating health-threatening behavior, willingness (i.e., openness to opportunity) predicts behavior. The results of the present study seem to suggest that asthmatic adolescents more often take the intentional pathway to smoking than the non-asthmatic adolescents. It appears to be that among asthmatic adolescents, smoking initiation is more often planned behavior than among non-asthmatic adolescents. Explanations for this difference can be found in the literature about moderators of the effect of cognitions on behavior, such as accessibility, temporal stability, involvement, and certainty which all strengthen the relationship between cognition and behavior (Cooke and Sheeran 2004). Because of their illness and their increased health risks of smoking, asthmatic adolescents may contemplate more on smoking and therefore smoking cognitions may be more accessible from memory, may be more stable over time, the asthmatic adolescents may be more involved in the topic of smoking, and will be more certain about their cognitions. As a result, these cognitions will be better predictors of smoking among asthmatic adolescents, and smoking will be more of a deliberate choice instead of a response to the circumstances.

Implications

The results of this study show that non-smoking asthmatic adolescents have more negative attitudes towards smoking, more PBC and lower intention to smoking. Given the increased health risk of smoking for asthmatics, this is the desired result. However, our previous cross-sectional study using the same sample but also including smokers showed no difference in mean level of the cognitions, suggesting more cognitive dissonance reduction to occur in asthmatics. Once the transition to smoking is made, adolescents with asthma seem more likely to change their cognitions into pro-smoking cognitions, increasing the

likelihood to stay smokers and become dependent smokers, which is especially harmful for adolescents with asthma. PBC is the strongest predictor of intentions to smoke, and improving PBC, for instance by refusal skills training, seems an important cognitive factor to focus on in prevention programs. Because of the increased cognitive dissonance reduction for asthmatic adolescents, it is important to intervene before they even consider taking up smoking. It would be interesting for future research to test what causes this increased tendency to have more positive cognitions after smoking onset among asthmatic adolescents.

The results also show that asthmatic adolescents are more affected by the subjective norm of parents than non-asthmatic adolescents. Parents of asthmatic adolescent could be targeted in smoking prevention programs for adolescents with asthma. They should be informed about the importance of disapproving smoking, and enforce more parental pressure to refrain from smoking. Smoking prevention programs aimed at parents have proven to be successful in reducing smoking initiation during adolescence (e.g., Jackson and Dickinson 2006).

Furthermore, our findings show that the predictive power of the TPB is stronger among adolescents with asthma, suggesting that smoking among asthmatic adolescents is more often planned behavior. Future research should focus on what determines the predictive power of health-specific cognitions for health behaviors, i.e., under what conditions health behavior is more deliberately planned. For smoking as well as other health-risk behaviors, particularly vulnerable adolescents may be guided more by their cognitions because they contemplate more on these risky behaviors. These groups of adolescents may benefit more of TPB-based interventions.

Strengths and Limitations

The results of this study are based on a large population-based sample of adolescents, using a longitudinal design and sophisticated analyses using SEM. Despite these strengths, this study has some limitations. In this study, we focused solely on smoking onset, and did not investigate the TPB with regard to transitions in smoking behavior. Future studies should also explore the effect of smoking-specific cognitions on other transitions in smoking behavior of asthmatic adolescents.

Furthermore, our results are based on self-reports of smoking. However, studies have shown that self-reports on smoking are reliable and valid when anonymity is guaranteed (Barnea et al. 1987; Forastiere et al. 1993), and prevalence estimates of smoking were similar when using self-reports or a biological markers (salivary cotinine) (Dolcini et al. 2003). On the other hand, this has not been examined in adolescents with asthma. It may be that they have a higher tendency to underreport smoking. This study also used self-reports for assessing asthma by using the ISAAC questionnaire. Due to the large sample size it was not possible to verify asthma status by more objective physical measures of asthma. However, the ISAAC questionnaires are widely used in epidemiological studies on juvenile asthma (e.g. Asher et al. 2006), and the questionnaire showed to be sensitive and specific in measuring asthma when compared with a physician's assessment of asthma (Jenkins et al. 1996).

Finally, we did not test the differences between asthmatic and non-asthmatic adolescents with multigroup analyses, due to the large difference in sample size. There is still ongoing debate in the SEM-literature whether or not it is possible to test for multigroup differences with such sample size differences. Therefore, we decided to test and report separate models for the asthmatic and non-asthmatic adolescents.

Conclusion

The results of this study showed that the TPB is useful in predicting smoking onset in adolescents, and in a specific group of asthmatic adolescents. Among the latter group i.e., adolescents who are especially vulnerable to the effects of smoking, the predictive value of the TPB is higher than among the general population of adolescents. Our results suggest that adolescents who feel more vulnerable to a particular health risk are more often deliberately plan health-threatening behavior. In these vulnerable groups, TPB based interventions are probably more successful.

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Appendix: Questionnaire Items and Response Scales

Pro-smoking Attitude: 7-Point Likert scale

I think daily smoking is…

1. Unpleasant (1) to pleasant (7)
2. Harmful (1) to innocent (7)
3. Useless (1) to useful (7)
4. Boring (1) to exciting (7)
5. Hazardous (1) to harmless (7)
6. Unhealthy (1) to healthy (7)
7. Bad (1) to good (7)

Perceived Behavioral Control (PBC): 5-Point Likert scale

1. Not to smoke if my friends smoke is…very difficult (1) to very easy (5) for me
2. To refuse a cigarette when it is offered to me is…very difficult (1) to very easy (5) for me
3. To stay or become a non-smoker is…very difficult (1) to very easy (5) for me
4. To think of a reason not to smoke is…very difficult (1) to very easy (5) for me
5. To explain why I do not want to smoke is…very difficult (1) to very easy (5) for me
6. To respond when someone thinks I am a coward because I do not smoke is…very difficult (1) to very easy (5) for me

Subjective Norm: 4-Point Likert scale

1. Do you think your best friend would approve when you smoke (or would smoke)? Definitely not (1) to definitely yes (4)
2. Do you think your friends would approve when you smoke (or would smoke)? Definitely not (1) to definitely yes (4)
3. Do you think your parents would approve when you smoke (or would smoke)? Definitely not (1) to definitely yes (4)

Intention

Which of the following statements applies to you?

1. I am sure I will never start smoking
2. I think I will never start smoking
3. I think I will start smoking in the future
4. I think I will start smoking within 5 years
5. I think I will start smoking within 1 year
6. I think I will start smoking within 6 months
7. I think I will start smoking within 1 month

Smoking Behavior

Which of the following statements applies to you?

1. I never smoked, not even a puff
2. I have tried smoking, but I do not smoke anymore
3. I have quit smoking after smoking less then once a week
4. I have quit smoking after smoking at least once a week
5. I try smoking every now and then
6. I smoke less than once a month
7. I smoke less than weekly, but at least once a month
8. I smoke less than daily, but at least once a week
9. I smoke at least once a day

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